green tape using an embossing tool. The green tape is embossed using suitable heat and pressure. The advantages of using embossing to form a channel for a conductive line for example, instead of screen printing the line, is that the line definition can be much improved. Screen printed conductor lines extend above the surface of the green tape, and during the lamination and firing process, these lines become squashed down, distorting the line. By the present embossing process, a channel, the reverse shape of the desired line, is formed in the green tape surface, and this channel is then filled completely using a standard screening method. Since the conductor ink does not extend above the surface of the green tape, it is not affected by the lamination process, and since the conductor channels can be completely filled, the line definition does not become distorted on laminating or firing the green tape. The IBM method, which uses an organic layer between the green tape surface and the embossing tool, cannot achieve the same line definition. Further, the excess organic material may give problems during the firing step as it is vaporized.

Claims 1 and 2 have been rejected as anticipated by IBM. The IBM disclosure coats the surface of a green tape with a PVE

coating prior to embossing. Such a coating is not commercially available, and no details are given in the reference as to how thick such a layer is; and the properties of the layer are unknown as well - the molecular weight, the nature of the solvent used and the like. Nevertheless the reference states that the PVA coating strongly adheres to the green tape after the Mylar® tape coated with the PVA has been peeled off. If the PVA layer is very thin, it would appear that the embossing tool would break through it, causing tearing of the PVA film that would interfere with the embossing. If the PVA is thick and remains whole after embossing, it would not be removed until the green tape is fired. A thick PVA layer would vaporize during firing, and either a channel or opening would be incompletely filled, when the channel or opening would not be true to the desired size after firing, or cause problems such as bubble formation as the green tape is fired. Thus applicants do not believe this was ever a practical method to use.

Further, applicants submit a Declaration under 37 CFR 1.132 by Dr. Barry Thaler, stating that the description of the method in the reference is insufficient to advise one skilled in the art how to make an embossed opening using a PVA layer. The PVA has an

unknown composition and an unknown thickness. Further, he declares that, in view of the many unknowns, he would not be able to duplicate the IBM work. He further declares that a PVA coated MYLAR® substrate casting green tape is unknown as a commercial product.

In any event, with the present-day requirements for exactly sized openings, which the present metal supported system permits due to the excellent shrinkage control in the x and y directions, the presence of PVA on the surface of the green tape or partially filling the embossed channels and openings, would preclude the IBM system from being used for the present purposes. Indeed the reference is careful to state that the organic vehicle of the filler materials must not attack or solubilize the PVA coating. But the solvents which would do so are not specified in the reference either.

One of the big differences from the IBM green tape stack and the present metal supported system is that the metal supported green tapes do not shrink on firing in the x and y directions. All of the green tape shrinkage that occurs during firing is in the z or thickness direction. This enables one to keep channels and openings to very close tolerances, impossible to achieve

using the method of IBM. In addition, it would appear that the presence of an organic material on the surface of the green tape would further interfere with forming channels and openings that are true to size after laminating and firing.

Claim 1 has been amended to preclude the presence of a film between the embossing tool and the surface of a green tape. Thus claim 1 is not anticipated by IBM. Entry of the amendments to the claims is urged as placing the claims in condition for allowance, or, at the least, reducing the issues on appeal.

Claim 3 depends from claims 1 and 2, and thus requires a bonding tool to be used directly on the surface of a green tape, which the IBM reference does not teach.

Claims 4-8 and 11 have been rejected as obvious over IBM in view of Vitriol et al. Vitriol discussed the development of co-fired green tape technology and discloses the problem of shrinkage in x, y and z directions. Improvements were made by first screening a circuit pattern on a rigid substrate, and then adding and firing a green tape thereon. This provides improved x and y dimensional stability during firing. However, he suggests that each green tape layer be separately screen printed and co-fired with the existing substrate supported fired green tape.

Vitriol et al addresses the problem of forming shaped green tape multilayer stacks. Vitriol et al disclose screening other components such as resistors, capacitors, inductors on the green tapes prior to firing.

However, the presence on the green tape of IBM of a separate organic layer would surely interfere with dimensional accuracy of the components co-fired on the tapes of Vitriol et al as well. Applicants concede that one skilled in the art would know how to prepare resistor inks and capacitor inks in accordance with claims 4-8 and 11. However, neither of these references disclose embossing a channel or opening directly on the surface of the green tape, as required by the present claims. IBM adds an organic layer to the green tape prior to embossing, and Vitriol et al do not discuss embossing at all.

Claims 9 and 10 have been rejected over IBM in view of Prabhu. Prabhu does teach supporting a green tape stack on a support substrate, and using a bonding glass to not only bond the green tape to the support, but to reduce the green tape shrinkage during the firing step. However, circuitry is applied by screen printing a conductive ink onto the surface of the green tape. No embossing is suggested to form channels for the conductive inks.

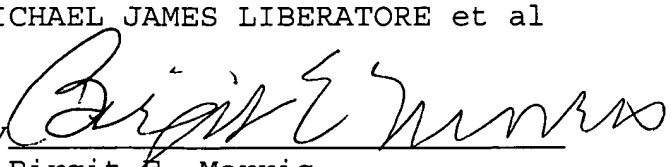
The problems with the IBM reference, e.g., that there is an organic layer of unknown thickness or composition in the embossed channels and openings in the green tape, has not been recognized by the Examiner heretofore. However, in view of the amendments to the claims, applicants' claims require embossing directly on the surface of the green tape. At the least, applicants' embossed openings will be truer to size than the IBM openings, and no problems will be encountered during firing of the organic layer, such as can be anticipated using the IBM method.

In view of the above amendments and discussion, and the Declaration submitted herewith, applicants request that the amendments be entered, the claims allowed and the application passed to issue.

If the Examiner believes a telephone interview would advance the prosecution of this application, he/she is invited to contact the undersigned.

Respectfully submitted,

MICHAEL JAMES LIBERATORE et al

By 

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